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ABSTRACT

The purpose of this study was to characterize and examine the social context of elementary students' interactions with science through their discourse. The influences of gender and culture on students' science conversations were studied in a semi-structured, student-run, whole class conversational format. Findings indicate that the discussion format allowed students to bring in personal experiences related to their cultural background and to use these examples as opportunities for listeners to experience the speaker's world from his or her own perspective. Additionally, a pattern of gender clustering was observed in students' seating, turn-taking, and content contributions. Students tended to choose next speakers of the same gender. The pattern resulted in a collaborative development of the floor by gender. Same-gender students aligned with and built upon previous speakers' comments. It was concluded that more open-structured formats such as these science conversations showed promise of expanding the discourse to include more students by recognizing and valuing culture and gender along with other social dimensions. Contains 28 references. (JRH)

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Gender and Cultural Aspects of Elementary Science Conversations

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Abstract

We studied the influences of gender and culture on students' science conversations in a semi-structured, student-run whole class conversational format. Elementary students in a first-second and second grade classroom engaged in weekly half-hour science conversations around a particular topic that the classes were currently studying. Students had major autonomy in choosing speakers and guiding the conversations. The discussion format allowed students to bring in personal experiences related to their cultural background. Students used these examples as opportunities to "*world*"*-travel* (Lugones, 1987) allowing listeners to experience the speaker's world from her or his own perspective. Additionally, a pattern of *gender clustering* was observed in students' seating, turn taking and content contributions. Students tended to choose next speakers of the same gender. The pattern resulted in a collaborative development of the floor (Edelsky, 1981) by gender. Same gender students would align with and build upon previous speakers' comments. More open-structured formats such as these science conversations show promise of expanding the discourse to include more students by recognizing and valuing culture and gender along with other social dimensions. However, when we attempt to free conversation, we must closely examine how social factors *both* expand and constrain the discourse. The discourse communities examined in this study show promise of *expanding the discourse* (Weiler, 1988) by recognizing and valuing the social dimensions of science conversations.

Introduction

The purpose of this study was to characterize and examine the social context of

elementary students' interactions with science through their discourse. This work occurred in a professional development school with a largely international population accommodating many students with beginning English skills. Previously, our work has focused on language through the integration of science and literacy with particular attention to oral discourse.

In this analysis, we looked at the influences of gender and culture on students' science conversations in a semi-structured, fairly autonomous whole class conversational format similar to that used by Gallas (1995). In these conversations teachers asked students to *agree* or *disagree* with a topic statement or question and give their *reasons* for their responses. Students had major responsibility for choosing speakers and guiding the conversations. We were interested in how gender and culture served to include, marginalize or exclude students from the large group science conversations in a culturally diverse school setting.

Theoretical Perspectives

By expanding the focus of research from students' interactions with scientific content to the larger community within which students learn science, we concern ourselves with many more factors: the environment in which students learn, the gender, class and cultural background of students, the language students use, interactions among students, etc. To address these issues we draw from sociocultural and feminist perspectives.

Gee (1991) has identified the importance of examining discourse as a fundamental characteristic of a community. He informed our concern with inclusion of students in school discourse by showing that students from non-mainstream homes (minority and lower socioeconomic status) often do not have sufficient opportunity to acquire secondary discourses such as those operating in schools. Many other researchers have also looked at the influence

of culture in acquiring discourses. Michaels (1981) has documented the differences in discourse patterns of African American students and European American students. She found that African American students tend to speak in "topic associating" styles whereas European American students speak in "topic centered" styles. In classrooms European American teachers are typically capable of supporting the discourse styles of European American students better than African American students. Heath (1983) described the translation process that working-class African American students engaged in as they "moved between the personalized, contextualized orally expressed knowledge of home to the depersonalized, decontextualized, primarily written knowledge of the classroom" (p. 321).

Philips (1962) studied cultural factors affecting American Indian student participant structures. She examined the reluctance of American Indian children to speak in school and outlined how the norms governing the Indian children's discourse came from their home communities. These differences in home and school discourses prevented the formation of a common school speech community.

In addition to these studies of classroom discourse, we have also drawn on sociocultural research specifically within the discipline of science. Lemke (1990) has outlined how talk in science classrooms typically follows an initiation-response-evaluation format providing a clear contrast to the free discourse patterns in the classrooms we studied. Rosebery, Warren and Conant (1990) addressed cultural factors by studying Haitian Creole students who learned science using their native language. Michaels and O'Connor (1990) aided our thinking about powerful discourse that is owned by students in their report of creating a "discourse space" that allows students to bring divergent discourses but which is also orchestrated by the teacher so that

students make scientific discourse their own by taking on multiple roles and explicitly talking about discourse.

Feminist researchers are also interested in the appropriation of discourse in the classroom. We are constructed as social beings by language, and Cameron (1992) suggests that that construction is different for women and men. She argues that women may be alienated from and marginal to traditional language created and dominated by men. Cameron goes on to cite the "inequality of conversation opportunity" (p. 71) and attributes this inequality to lack of access to powerful discourse styles for women (Lakoff, 1975) and/or men's linguistic privileges due to their socially dominant position.

Children's speaking styles show distinctive differences according to gender. Maltz and Borker (1982) postulate that some of these differences arise out of girls' and boys' play groups. Girls emphasize intimacy and reduce conflict as a result of interactions in small play groups. Boys develop direct, confrontational speaking styles due to large, hierarchically organized play groups.

Cameron (1992), however, cautions against a monolithic analysis of language based solely on gender. In acknowledging the impact of gender on our identification as social beings, Cannon, Higginbotham and Leung (1991) state that race and class are critical features that shape us and must also be brought explicitly into the research process. In terms of race, Conway and Bourque (1993) substantiate women's inequality due to "access and educational experience" in Asia, Africa and Latin America as well as in the United States (AAUW, 1992).

Gender inequities are predominant in the discipline of science as well as in language and education more generally. Feminist critiques of science (Harding, 1987; Keller, 1985; Hubbard,

1989) reveal the European male dominated origins of the discipline and argue for a revisioning of science that includes other voices and personal experiences. The AAUW Report (1992) documents girls' lesser achievement and participation in science in schools.

The preceding studies have enriched our understanding of the social context of discourse in science classrooms. In this study we wished to look at some of the ways in which gender and culture influenced students' interactions in weekly whole class science discussions. We were interested in students' participation and content contributions and particularly wanted to investigate how students were included or marginalized in the conversations.

Modes of Inquiry

We drew from qualitative research methods specifically focusing on ethnography (Hammersley and Atkinson, 1983) and sociolinguistic analysis (Florio-Ruane, 1987). One member of the research team observed, recorded field notes and videotaped weekly half-hour science discussions and periodic science lessons in a first-second and a second grade classroom over the course of one school year. Both classroom teachers were interviewed individually about factors affecting student participation and the progression of the discourse in three one-hour sessions at the beginning, middle and end of the year. A subset of students representing differing genders, cultural backgrounds and participation patterns in the science conversations were interviewed in half-hour sessions individually or in pairs at the end of the year. Students were asked about the nature of their participation in the science conversations and their content understanding.

Gender and cultural patterns emergent from the data were identified and documented using a Filemaker Pro database system. Specific video segments highlighting gender and

cultural patterns were studied more closely using discourse analysis (Erickson and Shultz, 1977) and verified as type-cases consistent with examples from the larger data pool. Two typical class discussions showing gender patterns in turn taking were analyzed more closely to determine potential links between gender and content contributions.

Primary assertions were proposed about patterns of interaction and the roles of gender and culture affecting inclusion in the discussions. These assertions from the conversation video tapes were supported or disconfirmed with other data sources including field notes and teacher and student interviews. Gender and cultural patterns were then reported thematically across students and classrooms.

Findings

These innovative discourse communities allowed students to experience more open and flexible forms of communication and learning than typically occur in traditional classrooms with teacher-centered discourse. The structure of the conversations included the following components. Science conversations occurred weekly for 15-30 minutes. Students sat in a circle on a floor of a classroom where furniture had been moved to provide an open space for the conversations. The teachers, Mrs. G and Mr. K, began the talks by presenting the students with a statement or question about a science topic they were beginning or currently studying. The teacher would call on the first student to agree or disagree with the statement and give a reason. That speaker would then have responsibility for calling on the next student. In general, the students had primary responsibility for the conversations with the teachers intervening occasionally to introduce a new strategy, remind students when they had broken norms or help students who had difficulty choosing the next speaker.

Students were encouraged to bring their personal experiences to the conversations which sometimes involved direct or indirect references to a student's culture. The students used these examples as opportunities to *"world"-travel* (Lugones, 1987) allowing listeners to experience the speaker's world from her or his own perspective.

As well as culture, students' gender positionings were clearly evident in the conversations. A pattern of *gender clustering* was observed in the students' seating, turn taking and content contributions. Students tended to choose next speakers of the same gender. This pattern resulted in a collaborative development of the floor (Edelsky, 1981) by gender. Same gender students would align with and build upon previous speakers' comments. Gender shifts in turns were often accompanied by shifts in scientific content and collaborative development of new ideas by successive same gender speakers.

"World"-Travelling

Maria Lugones' (1987) concept of "world"-travelling was valuable in helping us to understand the importance of culture in students' science conversations. For that reason we first describe the concept developed by Lugones and then show how it related to the children's personal experiences with science and their discussion of those experiences.

The Concept: Recognizing and Valuing Culture

Maria Lugones (1987) helps us to understand the opportunities and challenges created by explicitly confronting different cultures. She has created an intriguing and "playful" invention of "world"-travelling, a concept that allows us to experience the culture of others in ways that are authentic, respectful and fun. Lugones tells us that outsiders are forced to "world"-travel as marginal members of the majority culture, but she also encourages those in the mainstream

to try it as well.

> ...the outsider has necessarily acquired flexibility in shifting from the mainstream construction of life where she is constructed as an outsider to other constructions of life where she is more or less 'at home.' This flexibility is necessary for the outsider but it can also be willfully exercised by the outsider or by those who are at ease in the mainstream (p.3).

Lugones goes on to say that the practice of "world"-travel requires a great deal of skill. However, outsiders and those in the mainstream have not recognized that skill because racism has a vested interest in devaluing it. Also, outsiders have not fully seen the value of "world"-travelling because they have been forced to travel to mainstream worlds that are often hostile. Maria Lugones advises that we should "affirm this travelling across 'worlds' as partly constitutive of cross-cultural and cross-racial loving" (p. 3-4).

Lugones claims that to have a complete sense of ourselves, we need to identify with others. She provides a way to make that identification through "world"-travelling.

> We are fully dependent on each other for the possibility of being understood and without this understanding we are not intelligible, we do not make sense, we are not solid, visible, integrated; we are lacking. So travelling to each other's "worlds" would enable us to *be* through *loving* each other (p. 8).

Lugones' conception of a world is multiple, flexible and dynamic. She cautions against a rigid definition as she wants to keep the idea open and suggestive.

> For something to be a "world" in my sense it has to be inhabited at present by some flesh and blood people. That is why it cannot be a utopia. It may also be inhabited by some imaginary people...A "world" in my sense may be an actual society given its dominant culture's description and construction of life, including a construction of the relationships of production, of gender, race, etc. But a "world" can also be such a society given a non-dominant construction, or it can be such a society or *a* society given an idiosyncratic construction. As we will see it is problematic to say that these are all constructions of the same society. But they are different "worlds" (p. 9-10).

Worlds can be big, little, incomplete, traditional or visionary. Inhabitants may not hold

or understand the ways that they are constructed in different worlds. One can inhabit different worlds at the same time and be different in those worlds.

In order to *be* in different worlds, one must *travel*. Maria Lugones describes "travel" in the following ways.

> The shift from being one person to being a different person is what I call "travel". This shift may not be willful or even conscious, and one may be completely unaware of being different than one is in a different "world," and may not recognize that one is in a different "world." Even though the shift can be done willfully, it is not a matter of acting. One does not pose as someone else, one does not pretend to be, for example, someone of a different personality or character or someone who uses space or language differently than the other person. Rather one is someone who has that personality or character or uses space and language in that particular way (p. 11-12).

Maria Lugones' conception of playful "world"-travelling permits us to experience and identify with others unlike ourselves. "...by travelling to their 'world' we can understand *what it is to be them and what it is to be ourselves in their eyes*" (p. 17).

Lugones' conception of "world"-travelling is so powerful because it transforms experiences of oppression into opportunities to be creative. We would now like to turn to the many opportunities and a few missed opportunities to "world"-travel in the multicultural first-second and second grade science classrooms.

"World"-Travelling in the Children's Conversations

Every Friday the students sat in a circle on the floor and had a conversation about a science statement or question. One Friday the teacher, Mrs. G., asked the students to agree or disagree with the statement, "All plants die in the winter." Here is a portion of their conversation.

Audrey: I agree [with the statement] because me and my mom left a plant out in the winter to see if it would die, and when spring came, it died...

Manuel: I disagree because in _____(Manuel's home country in Latin America), no plants die in the winter.
Mrs. G: What's winter like in ____ (Manuel's home country)?
Manuel: It doesn't snow. You don't have to wear snow boots. You can wear tennis shoes.
Mrs. G: But all the plants live? Do they change at all?
Manuel: Well, at least their flowers fall off, but they're still alive.
Mrs. G: But in the winter the flowers drop off?
Manuel: Yeah.
Mrs. G: Boy, that's interesting. Thanks for sharing...
Hasima: Plants don't die in the winter. The snow is like a blanket, and it protects it from the storms and the rain.
Audrey: I disagree with Hasima and Manuel because Hasima's talking about their country, and Manuel is talking about _____ (his country).
Mrs. G: So what do you think we should talk about?
Audrey: America.
Mrs. G: Think so? When it's your turn, can you say, "I'm talking about all plants in America," and when Manuel talks, can he say that he's talking about all plants in ____ (his country), and just change it a little bit? (Audrey nods, yes.) That's okay. Sure.

Audrey is an African American student. Most of the students in this school, however, come from countries other than the U.S. Audrey had difficulty becoming a *playful* "world"-traveller. She did not take up the invitation to "world"-travel and instead held tightly to her own "world," the United States.

The other students in the class and their teacher, Mrs. G, a European American woman from the United States, helped us to see the wonder and fun of "world"-travelling. Mrs. G's *playfulness* with "world"-travelling in the face of Audrey's opposition reinforced our reading of Maria Lugones creating her own liveliness in a potentially oppressive situation. Mrs. G encouraged the students to share their "worlds," and she eagerly travelled with them.

Mila: I agree that it [a plant] dies in winter, but some places near the equator, they don't die. If you don't put any water, they will die. If you put enough water, they won't die.
Mrs. G: How about _____ (Mila's home country in Asia)?
Mila: Yeah, they won't die. If you put too much water, they'll die, or no water, they'll die.

Mrs. G: Do they have winter in _____?
Mila: No.
Mrs. G: They don't even use that word? What seasons do they have?
Mila: They only have summer.
Mrs. G: Do they have a season called rainy season?
Mila: Yeah.
Mrs. G: What do the plants do in the rainy season?
Mila: The water will be very strong, but it will help the plant.
Mrs. G: So all that rain during the rainy season is good rain. It doesn't destroy the plants? (Mila nods.) That's very interesting. Children, we can learn about other countries if you listen more carefully to each other.

Mrs. G took Mila's invitation to travel to her "world." We felt great excitement watching Mrs. G "world"-travel with her students. The less structured format of the science conversations permitted the sharing of students' life experiences. These experiences show a more complex, but more complete picture of science that includes culture.

Mr. K's class also had many opportunities to share their cultural experiences during science conversations. In one conversation, students were discussing the statement, "Water is in air," with their intern teacher, Ms. C. Some students said that water was invisible, and Ms. C asked for an explanation of this point.

Gary: Um, Ms. C, when you said, "Can someone explain this invisible thing? How do you know it's there?" Well, um, you can feel the air 'cause blowing, and, um, it's kind of wet, and you can feel it blowing in your face.
Ms. C: Can I feel it right now?
Students: Nooo.
Lucas: Like when you're cooking the rice in a rice cooker. The steam goes out of it, and you can feel it like wet.
Ms. C: Okay.
Lucas: It's wet.
Ms. C: Be careful. That will also burn you.

Lucas was the first student to use a cooking rice example to demonstrate the concept of invisible water in the air. He discussed a personal experience of feeling wetness from a boiling pot of rice as evidence for the existence of invisible water in air. About five minutes later, Yue

asked the question, "Is steam made out of water?" After a few responses, she also shared her personal experience with cooking rice.

Yue: Every time my mother cooks rice, steam comes out of the pot.
Ms. C: Is it coming from the water or coming from the rice?
Students: (Loudly) Water.

The chorus of students' responses following Ms. C's question may indicate similar personal experiences cooking rice. The example of cooking rice seemed to provide a concrete context in which students could explore the more abstract context of water in air. The merit of this example continued through the conversation. About five minutes after Yue posed her question about the steam and rice example, Zan again asked Yue what her question was.

Yue: My question was, "Is steam water?"
Zan: Oh, um, I have an answer to your question. Once, when my mom was cooking rice, she forgot to put water inside, inside our pot. So, when we cooked it, no steam came out, but steam was supposed to come out, and then my mother saw that, um, she, she didn't put water in it, so I think that water makes the steam.
Gary: I know.

The students' references to rice and steam occurred at the beginning, middle and end of the science conversation about water in air. The cooking rice example was a powerful, personal experience that many students related to in the discussion. Students remembered this reference in the conversation and continued to mention and elaborate it. By drawing on this personal experience that others could relate to culturally, Zan was able to finally answer the question, "Is steam water?" by recalling a time cooking rice without water and, therefore, without steam.

We saw further evidence that the example of cooking rice with water to understand steam remained with some of the students following the science conversation. When interviewing Preston, he again brought up Zan's reasoning using the cooking rice example.

Lori: Did you hear some really good reasons why from some of the other kids today?

Preston: Yeah.
Lori: Do you remember what those were?
Preston: Zan, that's the only one I know.
Lori: What did Zan say that was really good?
Preston: I forgot.
Lori: Ah, but you remembered at the time that she said something, and that it was good?
Preston: Yeah.
Lori: I remember her saying something right at the very end about how her mother put rice in the pot and forgot to put the water in. No steam came out, and so that's why she thought that the water made the steam. Do you remember her talking about that?
Preston: Yeah.
Lori: Was that a good one do you think?
Preston: Yeah.
Lori: And why was that good?
Preston: Because I think I agree with her.
Lori: Unhuh. Have you had that happen at your home?
Preston: No, my mom never forgets to put water in the pot.

Though Preston remembered that Zan had had a really good reason, he could not repeat it in the interview. However, when reminded of the reason, he said that he had agreed with it. When probed about the personal experience of forgetting to put water in a pot of rice, Preston readily related to the example by stating that his mother "never forgets to put water in the pot."

In this example, the students used a shared cultural experience to explore a science concept. In Mrs. G's class, students explored seasonal plant growth by considering different cultural examples. The teachers and students used the opportunities provided by the conversations to make culture explicit and beneficial to their work in science. Along with the exploration of different and similar cultural examples in conversation, the teachers would also note scientific contributions from particular students' home countries.

In a unit about dinosaurs, Mrs. G brought in a recent news clipping that reported the finding of two new dinosaur species by scientists. Mrs. G read that the dinosaur fossils had

been found in the Sahara desert in Africa. She pulled down a wall map to show the location of the Sahara desert. Initially, Mrs. G could not find the desert listed on her wall map and so consulted a globe. While she was finding the countries where the Sahara desert was located, an African student Alisha spoke quietly to her friend.

Alisha: The desert is on top of my country.

Using the globe and wall map, Mrs. G carefully showed students the countries where the Sahara desert was located.

Mrs. G: (pointing on the map) Some of the Sahara desert is in Algeria
Dong-Yul: and Libya and Egypt.
Mrs. G: and some of it is in Nigeria, and a little bit of it is in Mali, and part of it's in Libya. Part of it's in Egypt, and part of it's in the Sudan.
Alisha: (excitedly) Aw!
Student: Alisha!
Mrs. G: (to Alisha) So maybe they found those dinosaur bones in your country. It's possible. It doesn't say exactly what country. It just says they found them in the Sahara desert.

Alisha's comment to her friend showed her knowledge of the Sahara desert in reference to her own country. Mrs. G also took the time to name each country where the Sahara desert and the dinosaur fossils were found. Dong-Yul demonstrated his knowledge of the geography of the Sahara desert by helping Mrs. G name the countries where it is found. When Alisha's country was named, she exclaimed, "Aw!" and another student excitedly proclaimed her name. Mrs. G also recognized Alisha's country as the possible source of the fossils. Alisha appeared pleased at the attention to her country and its potential importance in this scientific finding. The comments by Mrs. G and the students showed the regard they all shared for highlighting cultural contributions to science.

Mr. K co-taught science lessons with Mrs. G. A few minutes later when he was

discussing the naming of dinosaurs with the students, he again emphasized the cultural reference to Africa.

Mr. K: Now, dinosaurs are named for a couple of different reasons usually. They can be named for where they were found, okay? And in this case, that's how part of this dinosaur got its name. Where was this dinosaur found?
Ellen: Africa.
Mr. K: Africa, so that's where "Afro" came from 'cause it was found in Africa. So part of that name was Africa.
Unika: (raising his hand) Afro?
Mr. K: "Afro" for Africa. They didn't call it Africa-venator. They called it "Afro". They shortened the name a little bit. All right? So a dinosaur can be named for where it is found.

Interestingly, both Ellen and Unika, the students who participated in this discussion, were from Africa. Ellen exuberantly named her home continent as the source of the dinosaur fossils. Unika explored the meaning of the dinosaur name by repeating "Afro?" He may have requested confirmation of the connection of continent to the dinosaur's name with his question. Mr. K affirmed his point that the dinosaur was named after the place where it had been found, and that place was Africa.

While the cultural contributions mainly served to enrich the class science, at times, there was also resistance by some students to the emphasis the teachers placed on the cultural origins of scientific findings. In a technology unit which focused on boat construction, Mr. K and Mrs. G made explicit reference to the cultural sources of different boat styles. They prepared bulletin boards with student drawings of boats from various countries.

During the unit Mr. K read a story to the classes entitled The Little Boat. As he read, he showed a picture of a large sailing boat in the book. Poor audio quality prevented an exact transcription of the tape, but the following excerpt from our field notes illustrates the episode.

Mr. K held up the picture of the large sailing boat to the class. Mrs. G asked the

> students what country the boat was from. Audrey said it was from America in a definitive tone. Mrs. G said that it was first invented by Arabs, but now the boat is used in many parts of the world including America [Field notes, May 6, 1996, 1:28 pm]

Audrey was the same African American girl in the earlier episode who said the class should only talk about plants in America. In this instance she again referenced her own cultural background in a strong, possibly prideful way. Mrs. G, however, emphasized the valuing of all cultures, not just American traditions. She showed the importance of recognizing the various cultural contributions of many different countries to our technical knowledge by correcting Audrey's conception that the sailing boat had originated in America. Mrs. G explicitly named Arabs as the developers of the large sailing boat. At the same time Mrs. G validated Audrey's comments by stating that many countries including America used this specific technology developed by the Arabs.

Often, science is traditionally taught as a culture free enterprise. Mr. K and Mrs. G taught science as a human enterprise that is heavily imbued with the culture of the people who practice it. The emphasis on culture provided opportunities as well as dilemmas for the teachers and students. Mrs. G and Mr. K along with their students enriched their science experiences by humanizing and personalizing science. Some students like Audrey resisted "world" travelling to other students' cultures and preferred to focus on their own cultural traditions. However, most of the students took pride in the contributions of their cultures and other cultures to science.

Gender Clusters and Alignment

As with our analysis of culture, the work of other authors (Edelsky, 1981; Tannen, 1994) who have studied gender was very influential in helping us to understand how gender impacted

the students' science conversations. We begin this section with an explanation of the concepts of gender alignment and topical cohesion by Deborah Tannen (1994) and collaborative development of the floor by Carole Edelsky (1981). We then share examples from the students' conversations which illustrate these concepts in their seating arrangements, turn taking and contributions of scientific content.

The Concepts of Gender Alignment, Topical Cohesion and Collaborative Development of the Floor

Deborah Tannen (1994) and Carole Edelsky (1993) have studied gendered features of language and provide helpful concepts in understanding the students' conversational format and content. As Maria Lugones helps us to better understand the place of culture in our discourse, Deborah Tannen examines a particular culture, the culture of gender in communication. Tannen (1994) and others suggest that women and men comprise their own cultural groups. Since our early socialization occurs in same-gender groups, we have established gender-associated communication styles.

Deborah Tannen studied two features of conversational coherence which have gender associations, physical alignment and topical cohesion. She defined the characteristics in the following way.

> By *physical alignment* I mean the ways that speakers position their heads and bodies in relation to each other, including eye gaze. With Schiffrin (1988), I take "topic" to be, simply, "what speakers talk about." *Topical cohesion* then refers to how speakers introduce and develop topics in relation to their own and others' prior and projected talk (p. 86).

Tannen observed the physical alignment and topical cohesion of same gender friends. For physical alignment she found definite gender associations in each of the groups. The girls

and women sat very close to each other with their bodies aligned facing each other. The findings for topical cohesion paralleled those of physical alignment. The girls' and women's talk was tightly focused, while the boys' and men's talk was diffuse.

Tannen summarized her findings by stating that girls and women and boys and men display their involvement in conversations in very different ways. These "gender differences can be understood as cultural differences" and may help explain the frustration we sometimes feel in mixed gender groupings.

> It is likely that one source of the most frequent complaint by women about their relationships with men-that men do not listen to them-issues from differences demonstrated by this study: Perhaps the men do not face them head on and maintain eye contact, do not pursue a topic at as great a length as women do, and respond to concerns either by raising a topic of their own concern or by denying or belittling the basis for the woman's concern. If cross-cultural differences are at play, then these patterns of conversational involvement do not indicate lack of listenership but rather different norms for establishing and displaying conversational involvement (p. 128).

Carole Edelsky is also interested in gender differences in conversation. In one study (1993), she attempted to examine gender and language in faculty committee meetings. However, she found that it was not easy to determine the turn taking mechanisms. She decided that she first needed to more fully develop the concept of "the floor".

Edelsky's research pushed her to develop a new conception, "collaboratively developed floors," floors which are constructed by the turns of multiple speakers.

> There were two main types of collaborative floors: seeming free-for-alls and, more frequently, cases of several people being "on the same wavelength"...it [free-for-all] shows much simultaneity, joint building of an answer to a question, collaboration on developing ideas...and laughter (p. 196).
>
> Other collaborative stretches of talk ["on the same wavelength"], however, seemed more "orderly" and less "noisy"; yet it still was not possible to say that any one person had the floor. Rather, the impression was that several people were "on the same wavelength," even if in a sequence, sharing in the creation of

an idea or a function (joking, suggesting, etc.) (p. 197).

> There were other times...when this collaboration was achieved both through attention to the same function (answering) and topic and also through matching and marked rhythm and intonation (p. 199).

> Elsewhere, joint development of meaning and/or function was accomplished by individuals contributing pieces of one idea. There were even same-wavelength episodes where two or more people built one hedge, aborting their turns on their own, uninterrupted, and unoverlapped (p. 200).

The collaboratively developed floors seemed to offer a more equal playing ground for women and men. Carole Edelsky comments on this discrepancy between the floors.

> Singly developed floors, characterized by monologues, single party control, and hierarchical interaction where turn takers stand out from non-turn takers and floors are won or lost, share features with other contexts in which women have learned they had best not assert themselves. Collaborative floors, however, are inherently more informal, cooperative ventures which provided both a cover of "anonymity" for assertive language use and a comfortable backdrop against which women can display a fuller range of language ability (p. 221).

Seating Arrangements in the Children's Science Talk

We made a successive examination of aspects of children's gender in the conversations beginning with their seating choices. Both classes usually held their conversations in a sparsely furnished classroom that was dedicated to professional development activities. In this way, the furniture could be moved to the sides of the room allowing the students to form a circle in the center.

At one point during the year, Mrs. G discussed with Lori the time it took for the children to form a circle. They had been involved in the conversations for quite some time, and we felt the process should be routine. Yet, the beginning of the conversations was always a bit chaotic as students found their places in the circle. We decided to observe more closely this beginning process and followed Erickson's and Schultz' (1977) suggestion of starting the videotaping prior

to the activity itself. We were then able to study the children's actions in forming a circle.

We found that even though students entered the room in an orderly line from their classroom, the line soon broke up when they entered the professional development room. Students jockeyed to find positions close to their friends or students with whom they were comfortable. The resulting pattern was one of *gender clusters*. (See Figures 1 and 4.) Students typically sat next to students of the same gender in clusters of three to nine students. Figure 1 represents Mr. K's class during a beginning science conversation, and Figure 4 shows the gender pattern in Mrs. G's class at the end of the year. Mrs. G's class size was smaller than usual as some students were attending an English as a Second Language class.

Turn Taking

After identifying the physical pattern of *gender clustering*, we next looked for gender patterns in turn taking. As discussed, students who had spoken had primary responsibility for choosing the next speaker in the conversation. The teachers intervened only if a student was having difficulty choosing a speaker, if students wanted to speak and were not being chosen or if there were too many girls or boys in a row.

Two representative discussions from the beginning and end of the year were analyzed for gender patterns. Figure 2 illustrates the turn taking pattern in Mr. K's class during an initial science conversation, and Figure 5 represents the turn taking pattern in Mrs. G's class at the end of the year. Figure 2 shows a clear division of turns. First the boys had a succession of turns, and then the girls did. The last three students to speak were chosen by Mr. K as time was drawing to a close for that day's conversation.

Figure 5 also shows *gender clustering* in student turns, but the clusters are of shorter

duration. The frequent shifts in the gender of turns taken occurred because Mrs. G intervened asking boy student O to pick a girl and then calling on boy student B herself after four girls had turns. As with Mr. K's class, Mrs. G called on students at the end of class to ensure that those who wanted to speak had an opportunity. She called on the last eight students.

At the end of the year, Mrs. G further developed the conversations by introducing a new strategy. After a student had given an opinion (agreement or disagreement) and a reason, a few students could ask clarifying questions if they did not understand a part of what the speaker had said. In keeping with the turn taking norms, these students would raise their hands, and the speaker would call on them. After a few clarifying questions and responses were concluded, the original speaker would call on another speaker to give a new opinion and reason. In Figure 5, the original speaker is labelled as a primary speaker. Students who ask clarifying questions are labelled secondary speakers and have smaller associated circular symbols. Interestingly, the secondary speakers do not follow the *gender clustering* pattern of the primary turns and are fairly evenly divided between girls and boys. There may have been some characteristic of the clarifying routine that made both genders comfortable or gave both genders access to the floor.

The black circles in the diagrams represent times when the teacher intervened in the conversations. Reasons for intervention included asking a clarifying question of a student, requesting a student to change the gender of the next speaker, calling the next speaker directly, etc. Both teachers provided comments equally to boys and girls.

Gender Alignment and Collaborative Development of Scientific Content

The relationships between the gender and scientific content of the students' contributions illustrating gender alignment, topical cohesion and collaborative development of the floor are

shown in Figures 3 and 6. The initial statement upon which the conversation was based is written in the top left corner of each diagram. A dotted line below the statement represents the statement's alignment in relation to the students' contributions. Parallel lines indicate contributions that are in agreement. Perpendicular lines indicate contributions that are in opposition. Overlapping parallel or connected perpendicular lines indicate an explicit reference to a previous student's or students' statements. Girls' contributions are depicted as thick lines with an adjacent letter identifying the student in correspondence with the letters on the other diagrams. Boys' contributions are represented by thinner lines with an adjacent letter referencing the student. Arrows show the flow of the conversation based on agreement or disagreement with the original statement. Students' contributions within the same arrow were collaboratively developed with reference and agreement with one or more of the previous speakers.

Figure 3 depicts a beginning science conversation in Mr. K's class. Mr. K picked the first student Sang-Ook (represented as "S" in Figure 3) who agreed with the statement, "Sight is more important than hearing." Sang-Ook picked another boy Evan (E) who then disagreed with the statement. There followed a series of boys (E, A, I, C) who all disagreed with the statement but also agreed with the immediately previous boy speaker. The following is a transcript of this beginning of the conversation with the student's identifying letter from the figure indicated in parentheses before the student's name.

(S)Sang-Ook: ...I agree because, um, because if you want to say something you can write it on a piece of paper. When other people are talking to you, they can write it on a paper, and you can read it (rest inaudible).
Mr. K: Sang-Ook, you may call on someone.
(S)Sang-Ook: Evan.
(E) Evan: I disagree with the statement because I think they're both the same?

Mr. K: Why do you think they're both the same?

(E) Evan: Um, because, we could see if there's a car coming, and you won't get run over. And you can hear the cars coming with the honker.

Mr. K: And so you're saying you couldn't make up your mind which one's more important.

(E) Evan: Both are.

Mr. K: Okay.

(E) Evan: Arshad.

(A) Arshad: I agree with Evan because, um, you can see strangers passing by, or when your friend wants to say something, and you want to know how to play it, then you might not remember. You might not remember. You might not hear anything, and you will just play the game, and you will be out or something. Uh, Irving, what do you think?

(I) Irving: I agree with Arshad because if you didn't, if you couldn't see or hear, a stranger could just pick you up, and you wouldn't even know.

Mr. K: Okay, I think we're getting away from the statement a little bit, though. Okay? The statement says, "Sight is more important than hearing." All right?

Mrs. G: Do they know what "important" is? You really need it more than you need hearing.

(I) Irving: Isaac, what do you think?

(C) Isaac: I agree with Irving because, because, um (pause), I forgot what I was going to say. I'll just pick someone (points to Yat-Sen).

After Evan (E) gave his disagreement with the statement and reason, Arshad (A) followed by agreeing (aligning) with Evan and collaboratively developing the reasoning. Irving (I), likewise, agreed with Arshad and further developed the reasoning. Isaac (C) continued the pattern by agreeing with Irving but then forgot his reason. The ideas showed topical cohesion and may have been fully developed. The next speaker, Yat-Sen (Y) then broke the pattern of gender alignment and collaborative development by disagreeing with the statement but not referencing a previous boy speaker.

Yat-Sen (Y) broke the gender turn taking pattern by calling on a girl, and then a series of girl turns ensued. As with the boys, the girls' developed patterns of gender alignment and topical cohesion (girls calling on and agreeing with previous girl speakers relating their comments to those of previous speakers) and collaborative development of the floor (expanding

the reasoning of the previous girl speaker). A section of the transcript beginning with Natalie's (N) turn and ending with Alexandra's (X) turn follows.

(N) Natalie: I agree with the statement because, um, if you didn't, you couldn't hear (pause), if you couldn't hear, your friend could write a statement that she wanted to tell you or something, and you could see it.

Mr. K: Okay.

(N) Natalie: Jill, what do you think?

(J) Jill: I agree, I agree and disagree with the statement. I disagree with the statement because if you were driving, if you were driving, you couldn't see where you were going, and, and you couldn't see, and you wouldn't know where you were going. And if you couldn't hear, if you were walking on the train tracks, and somebody was trying to tell you that a train was coming, you wouldn't know because you would just think that everyone was waving at you. Sook-Joo.

(O)Sook-Joo: I agree and disagree because, um, I agree and disagree because, um, that, because if you didn't have hearing, you couldn't see somebody writing or somebody could just write it on a paper and let you know what they were trying to say. And I disagree with the statement because if you didn't have hearing, you wouldn't really be able to see what they mean. Like Jill said, you would just think that the people might be just waving at you. Jennifer, what do you think?

(F)Jennifer: I agree with Sook-Joo because if someone was walking with you, and you can't hear, then you can just, then you can just walk behind, and then they will see them. And I disagree because sometimes when you can't see, and you can only hear, you can hear a car, and then you stop. And then you go on the sidewalk when the car's over, and then there might be another car, and then you start running and running, and you bump on the sidewalk...

(X)Alexandra I agree with Jennifer.

Natalie (N) did not align with the previous girl speaker, but in her reasoning, she did refer to a female friend thereby making a gender affiliation. Jill (J) then agreed and disagreed with the statement beginning a new series of gender alignment, topical cohesion and collaborative development of the floor that included girl speakers Sook-Joo (O), Jennifer (F), and Alexandra (X). Each girl agreed with the immediately previous girl speaker and expanded her reasoning. Like Isaac (C) in the previous transcript, however, the last speaker Alexandra (X) did not expand the reasoning. Again, the collaborative development may have run its course, and she may have thought the idea was fully developed. As with the boys, this break

in the pattern signaled a shift in the conversation. The next speaker Jill (J) disagreed with the first boy speaker, Sang-Ook (S). Sang-Ook's original comment is referenced by a dotted line connected to Jill's.

When we looked at the content of the collaboratively developed girls' turns (J, O, F, X) and boys' turns (E, A, I, C), we saw some similarities. The boys had disagreed with the statement expressing the opinion that sight and hearing are equally important. They then mainly gave examples of potentially dangerous situations (car running a student over, stranger picking a student up) in which both sight and hearing would be needed to prevent the danger from happening.

When the girls gained control of the speaker rights, they followed Jill's (J) lead in agreeing and disagreeing with the statement. Jill explicitly disagreed with the statement telling of a time (driving) when a person would need sight. She then did not state why she agreed with the statement but instead told of a time when a person would need hearing (a train coming with people waving danger that is not understood because a person could not hear). Sook-Joo (O) also agreed and disagreed giving examples of when someone would need sight (if someone was writing on a piece of paper) and hearing (referenced Jill's comment about a person waving at you). Jennifer followed the pattern set by the other girls. The girls shared examples of danger (train coming at a person, a car approaching) as did the boys along with other less physically dangerous examples involving difficulties with communication (someone writing on a paper, walking with another person). One boy, Arshad (A), also gave an example of difficulty in communication (not being able to understand the operation of a game). While the examples of the girls and boys had some overlap and some difference, each set of gendered turns had topical

cohesion amongst themselves. Despite the differences, the basic reasoning of sight and hearing being equally important seemed similar between the gendered groups.

Figure 6 shows similar patterns of gender alignment, topical cohesion and collaborative development of the floor in Mrs. G's classroom at the end of the year. The students were discussing the statement, "Air has a color." As in Mr. K's class, a series of boys' turns resulted in gender alignment, topical cohesion and collaborative development of the floor. The first series began with Jason (J) disagreeing with the statement that air had a color because he could not see any color. Mrs. G then asked if any students had clarifying questions for Jason. Clarifying was a strategy Mrs. G was working on with the students to expand their discourse. Two students, a boy (F) and a girl (I) in Figure 5, asked clarifying questions of Jason. Mrs. G usually limited clarifying questions to a couple of students so that speakers would not feel interrogated. After answering the clarifying questions (Figure 5), Jason (J) called on Unika (U) who agreed with him and expanded the reasoning.

(J) Jason: Unika, what do you think?
(U) Unika: Um, I agree with Jason because air doesn't have a color. It's like you can't see it, and there's no color. It's kind of like invisible, but I agree that there's no color. It's just like white. You can't see it.
(J) Jason: It's not even white. It's invisible.
(U) Unika: I know.

Mrs. G asked Unika to ask if anyone would like him to clarify his opinion. No one raised a hand. Mrs. G then asked Unika to ask for another speaker.

(U) Unika: Who would like a next turn? Darweshi.
(D)Darweshi: I agree with Unika because, because there's air in this room, and I agree with Jason. There's air in this room, but we cannot see the color because when you walk around, and you can see air in the sky. There's air everywhere you can find it, and when you kind of look up, there's no air. It's like it's invisible.

Darweshi (D) agreed with both Unika and Jason and elaborated the reasoning. Unlike

the beginning conversation in Mr. K's class, the students like Darweshi now tended to reference all of the previous speakers in the collaborative development of the floor rather than just the immediately preceding speaker.

Mrs. G next broke the boys' turn taking pattern by asking Darweshi (D) to pick Mei-Hua (M).

Mrs. G: Would you please call on Mei-Hua because she hasn't had any turns? Mei-Hua, do you agree with Darweshi that air has a color or doesn't have a color?
(M)Mei-Hua: Agree.
Mrs. G: You agree with him that air has no color. Do you want to tell anything about why you think so?
(M)Mei-Hua: No.
Mrs. G: No, okay. Darweshi, go ahead and call on somebody else then.

Mrs. G actually called on Mei-Hua (M) herself and proceeded to ask Mei-Hua's opinion. Mei-Hua was a quiet student who did not often speak in the science conversations. Mrs. G attempted to facilitate her entry into the conversation by giving Mei-Hua additional teacher support. Possibly because Mei-Hua was chosen by the teacher, Mrs. G gave speaker rights back to Darweshi as he did not have the opportunity to choose the next speaker. Mrs. G may have been implicitly modelling the choosing of different gender speakers as suggested by a later move. Darweshi, however, did not choose to pick a girl, and instead picked Justin (S).

(D)Darweshi: I guess Justin.
(S) Justin: I disagree with Unika, Darweshi, and Jason and Mei-Hua because air has a color. When you go outside, you see, that up in the sky, there's blue. That's the color of the air. (Students start to talk and disagree with Justin.)
Mrs. G: Wait, wait, you're not to argue with him. You, I think you understood what he said because that's why you started arguing. So if you want to respond, you raise your hand when he calls on somebody, and I think it's time to call on a girl because I see that we have, four or five boys had turns
(S) Justin: Unika.
Mrs. G: in a row.
(U) Unika: Aw, a girl.

(S) Justin: Audrey.

As with Mr. K's class, the pattern of collaborative development of the floor by Jason, Unika, Darweshi and Mei-Hua was broken. Possibly Mrs. G's facilitation of Mei-Hua's turn or Mei-Hua's statement without a reason signaled the shift. Although Justin (S) broke the collaborative development of the floor and agreed with the statement, he still referenced all of the previous speakers. It seemed important to the speakers to acknowledge individual ownership of previous opinions.

Mrs. G made an explicit move to shift the gender of speakers following Justin's turn. There appeared to be some resistance as Justin first called a boy, Unika (U). Unika voiced disappointment at the gender shift even though he had had a turn previously. Like Justin (S), Audrey (A) may have tried to keep the floor for the girls by next choosing a girl, Ellen (E), who did not have her hand raised. Audrey (A) may have been using her authority as speaker to include Ellen as she had often raised her hand previously without being called on until the end of the conversation after most other students had had a first turn. Alisha (L) vocalized this breaking of the norm, but Ellen (E) took the opportunity to speak and was ready with a complex reason that was further developed by succeeding speakers.

(A) Audrey: I disagree with Justin because blue is the color of the sky, not the air.
Mrs. G: That was pretty clear what she said, wasn't it?
(A) Audrey: Ellen, what do you think?
(L) Alisha: She didn't raise her hand.
(E) Ellen: Um,Part of, um, sometimes in the fog, the air has color. It's white, but usually air doesn't have color...Alisha, what do you think?
(L) Alisha: I agree with Audrey and Ellen, and I disagree with Justin, because blue is the sky, and see, the air doesn't have any color. I think, the air doesn't have any color because (pause) because if we don't have air, I think (pause)

Like Darweshi (D), Alisha (L) again referenced multiple previous speakers (A, E, S)

agreeing with the girls and disagreeing with the boy, Justin. Anita (T) and Boseda (B) also aligned with the previous speakers and collaboratively developed the idea that air can sometimes have color and sometimes not. While this idea was comprehensive covering both agreement and disagreement, Boseda (B) also referenced the early speakers, J, U, D (shown with a dotted line in Figure 6), indicating alignment with the preceding girls but also with the earlier boys.

Mrs. G: Boseda, would you tell us your idea before we go?
(B) Boseda: I agree with Jason, Unika and Darweshi because air doesn't have no color, and I agree with Ellen, because sometimes, when it's foggy, it's kind of like brown, a little bit brown outside.

When interviewing the students about how they chose speakers, we found some stating the norms that had been explicitly developed in the discourse communities.

Lori: After you give your idea, and if there is more than one hand raised, how do you decide who to pick next?
Evan: I just pick the people who were raising, which were raising their hands the most first.
Lori: Who raised their hands first?
Evan: Yup.

Evan claimed to make a decision based on who was raising a hand first. Rebecca similarly expressed a group norm of choosing a quiet person with raised hand. She later added a more personal decision to pick someone who was not mean to her.

Lori: How do students get picked to talk?
Rebecca: When you be quiet and raise your hand.
Lori: When you're done (speaking), how do you decide who to pick next?
Rebecca: Sometimes I pick the person who's not being mean to me.

Other students, however, spoke directly of same gender preferences. When discussing people who talk in the science conversations, Darweshi referenced other boys who were his friends. By stating that most of the girls did not talk, he may have seen only boys as the pool of students to choose for speaking.

Lori: Who doesn't want to talk?
Darweshi: Most of the girls.
Lori: I see. Why do you think that is?
Darweshi: Because maybe they're shy...
Lori: Now, who, you mentioned that the kids talk. Can you tell me more about, and that some of the girls don't talk, and who does talk?
Darweshi: Like me, and Boseda and Unika (all boys).

Natalie was very observant of the turn taking patterns and realized that they may have served to make same gender students, particularly girls, more comfortable. She was dissatisfied with the gender pattern, however, and spoke of breaking it herself.

Lori: How do students get picked to talk when you're in the big circle?
Natalie: Most of the time it's somebody that they like, and if it's a boy, most of the time, they pick on boys. But like Joey likes Jennifer, so if Jennifer was raising her hand, Joey might call on her rather than just a boy. 'Cause most of the times, if it starts out with a girl, it holds onto the girls, until, like, for instance, I like Irving. I might call on Irving.
Lori: Why are you comfortable picking Irving?
Natalie: I like him for a friend.
Lori: Sometimes you also pick girls?
Natalie: Mmhmm.
Lori: Why would you pick a girl?
Natalie: Well, because I want both people to have a chance, and some girls don't feel like I do, and they just pick on girls. And we only have a few girls in our class. They might just keep picking girls and girls and girls. And if I were the last girl to be picked on, I would pick a boy because they haven't had any chances. And I don't know if the girls would be comfortable, but I wouldn't care if they didn't feel comfortable because I want both people to have a chance. It's not like girls should be lucky only and have a chance to talk.

The *gender clustering* may have constrained the discourse in certain ways. Students' options of who to call on for the next turn seemed limited to students of the same gender unless the teacher intervened. Students' topical cohesion and collaborative development of the scientific content according to gender illustrates how social dynamics cannot be separated from content (Wortham, 1995). As in turn taking the students' expression of content may have been limited to connections with responses by students of the same gender.

On the other hand, the *gender clustering* may be viewed as a community building mechanism. Same gender turns may have allowed certain students to feel comfortable and contribute who otherwise might have had difficulty entering the conversation. The students may have felt their content contributions would be valued more highly by the same gender, and they may have felt more comfortable developing a set of ideas together as girls or boys.

In looking at the opinions expressed by the students as they collaboratively developed a floor, it is interesting to note that the floors developed by the girls in both Figures 3 and 6 expressed both *agreement* and *disagreement* with the original statements. In contrast, both sets of boys' floors *disagreed* with the original statements. The girls' opinions suggest a more relational, connected pattern of judgment in which they could see both sides of the argument depending on the context. The boys, on the other hand, may have more easily made autonomous, detached decisions that appeared straightforward. These modes of judgment are similar to those described in women's and girls' psychological development reported by Carol Gilligan (1982) and Lyn Mikel Brown and Carol Gilligan (1992). The responses by the students in this study may indicate very early socialization of these gendered patterns of judgment. We are interested in more closely examining the children's discourse to better characterize their judgments of scientific ideas and understand the features of the gendered spaces they create in collaboratively developed floors.

Discussion: Expansion of Classroom Discourse

Kathleen Weiler (1988) addresses the complexities of gender, race and class in communication as they are expressed by students and teachers. She explains that we bring differing and sometimes conflicting ideologies and experiences of "domination, submission,

oppression and privilege" to the classroom. By recognizing and discussing these various dimensions of ourselves within school, we can "expand the discourse" to be legitimating of more students' identities.

Weiler states that classroom discourse is not neutral territory. Students and teachers create meaning that "is always situated in the context of a socially and historically defined present" (p. 128-129). Discourse is used by both teachers and students "to assert their own power and to try to create sense for themselves out of a complex social setting" (p. 129). Typically, discourse is dominated by teachers in their establishment of the curriculum and norms of the classroom. However, students also participate and control part of the discourse. Teachers need to make students' intentions a legitimate part of the classroom discourse. The task is made difficult not only by the possibly conflicting intentions of students and teachers but also conflicts among different students. Subjectivities are constantly changing and "being redefined as meaning is asserted, contested, affirmed, or denied" (p. 129).

This community provided opportunities for expansion of the discourse that are often missed in traditional lecture or initiation-response-evaluation (Cazden, 1988) forms of discourse. The social aspects of the conversations, particularly culture and gender, both expanded and constrained the discourse.

Having the opportunity to share one's cultural background and experience others' cultural backgrounds in science is rare in many traditional classrooms which view science as a neutral, culture-free discipline. The freedom of these conversations allowed students expression of experiences in their home countries which enriched discussions and showed a more real view of science that is culturally laden (Harding, 1987; Hubbard, 1989; Keller, 1985). A few

students wished to acknowledge only American examples of science. However, most students and the teachers used the cultural examples as opportunities to *"world"-travel* (Lugones, 1987). Validation of students' culture experiences by the teacher and other students permitted access to the conversation by students wanting to share scientific knowledge from their home countries.

The students' patterns of seating, turn taking and sharing scientific contributions indicate that their views of the discourse community may have been limited to other students of the same gender. However, same *gender clusters* may have permitted more students to feel comfortable and included in the conversation. The *gender clusters* may have furthered the scientific conversations by allowing students to more freely develop ideas cohesively and collaboratively.

Traditional patterns of discourse in science classrooms have tended to exclude and marginalize some students, particularly girls and minorities. More open-structured formats show promise of expanding the discourse to include many more students. However, when we attempt to implement structures to free conversation, we must closely examine how social factors *both* expand and constrain the discourse and consequently include and marginalize particular students. The discourse communities examined in this study show promise of *expanding the discourse* by recognizing and valuing the social dimensions of science conversations.

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Figure 1
Seating Arrangement
Mr. K's Class

Figure 2
Turn Taking
Mr. K's Class

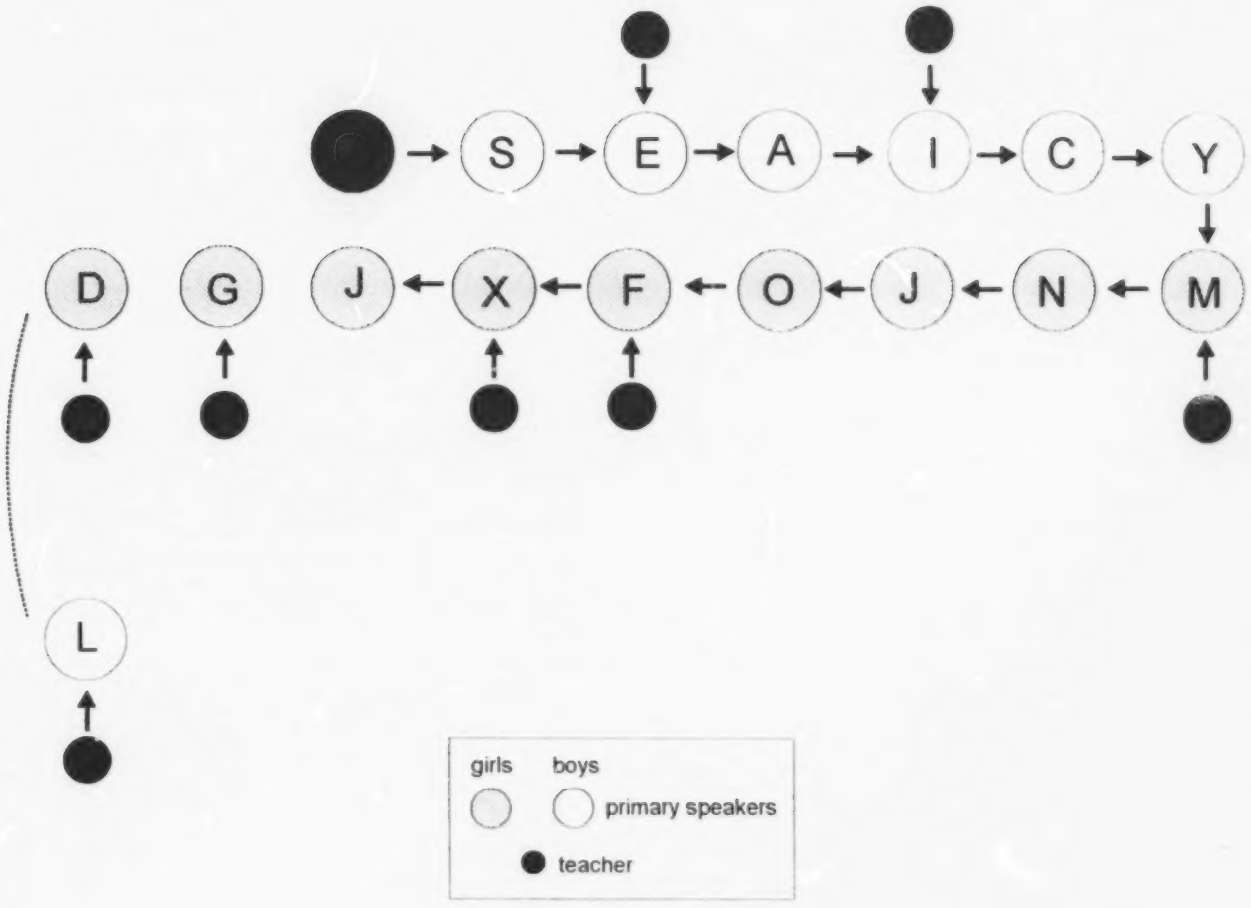

Figure 3
Alignment with Content and Speaker
Mr. K's Class

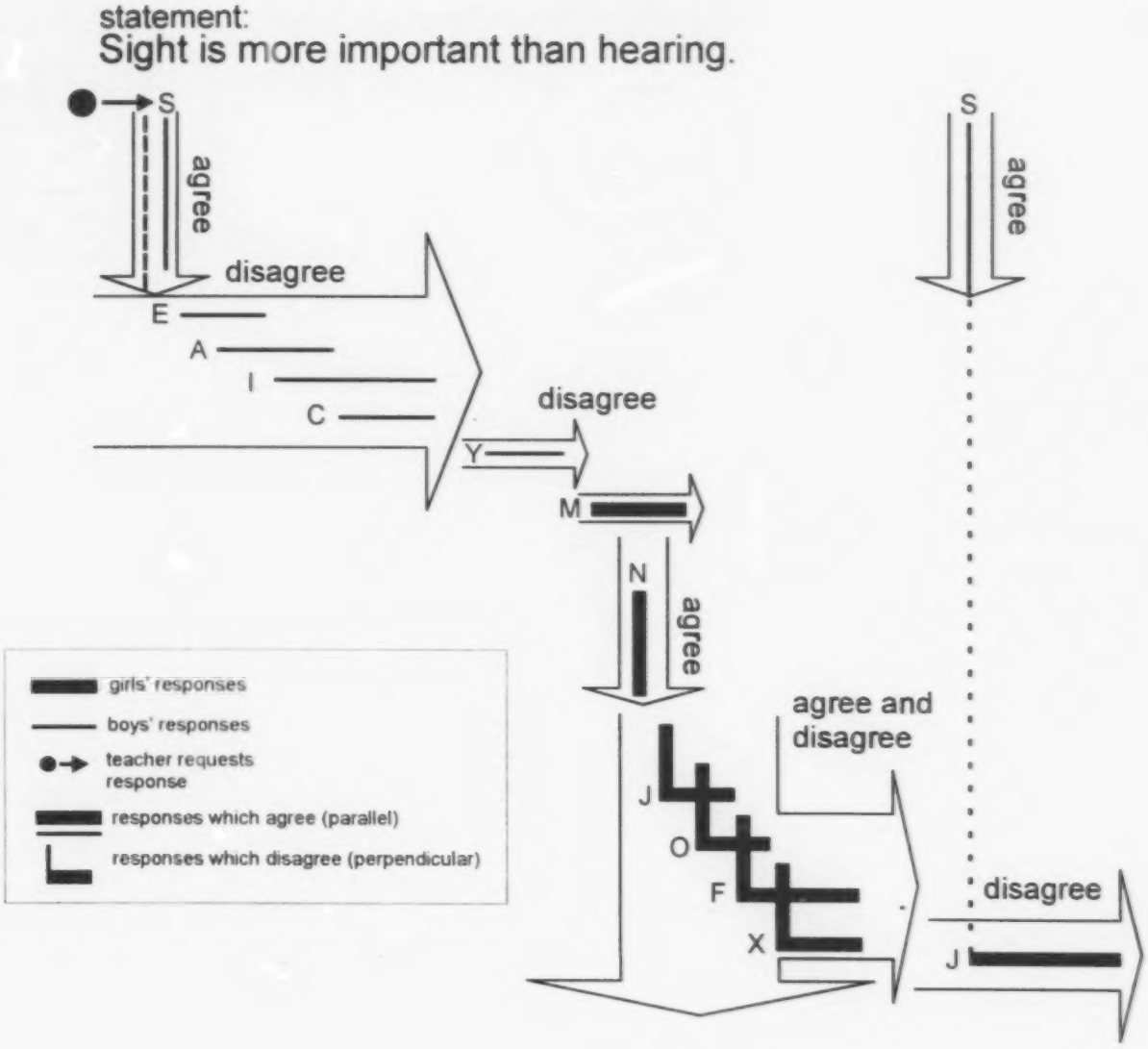

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Figure 4
Seating Arrangement
Mrs. G's Class

Figure 5
Turn Taking
Mrs. G's Class

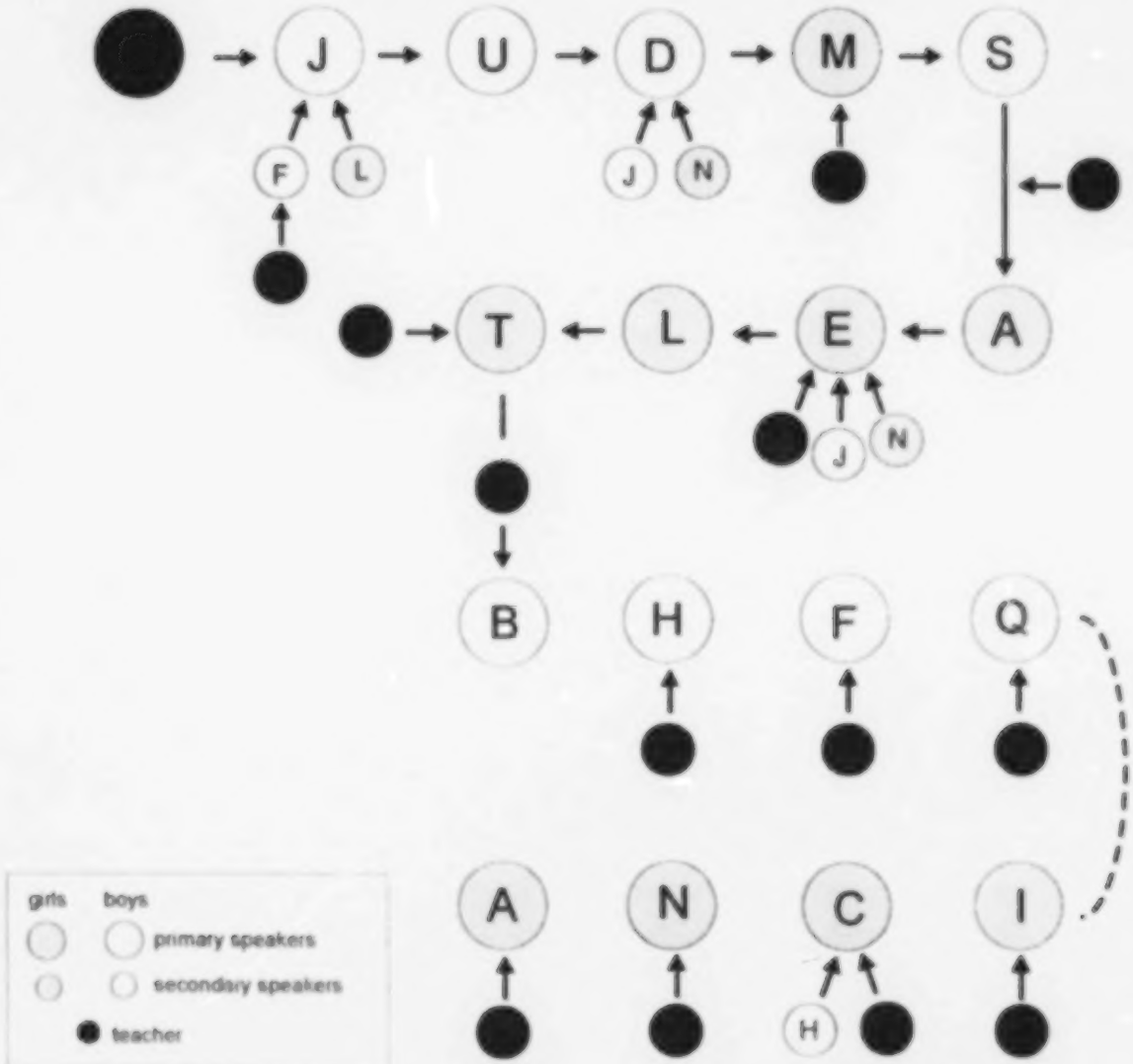

Figure 6
Alignment with Content and Speaker
Mrs. G's Class